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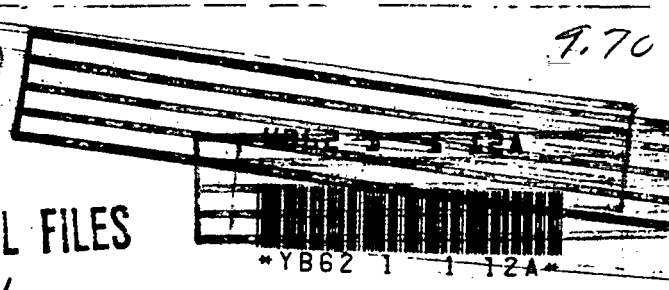

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To Mr. J. W. Ebert
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Attention
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Date October 28, 1952

Answering Letter Date

Subject Study of Mercury Contamination in Elex Pilot Plant.

Operating procedures of the Elex Plant calls for routine study by the Health Physics Department of the level of mercury contamination in the operating areas. Routine checks of August 1, 1952, indicated a very abnormal condition of contamination in this area. When this became known to supervision the Alloy Department requested the Health Physics Department to help make a survey of the mercury contamination conditions and to make recommendations for lowering the existing contamination.

The discovery of the abnormal conditions was alarming, since the level of the mercury contamination in the pilot plant area during June and July was relatively low and practically all samples were below the maximum allowable concentration of one milligram of mercury per cubic meter of air. On examination of ventilating conditions the following facts appeared: During June and July the general ventilating air entered the pilot plant area through the east doors and was drawn westward through the operating area by the exhaust fans located in the roof of the building. During the latter part of July the east doors were closed and the general ventilating air was exhausted from fans located in the eastern portion of the operating area. After the direction of air flowing through the pilot plant area was changed in this manner; the level of mercury contamination increased considerably.

The first phase of this study was to observe the effects of varied ventilating conditions upon the level of mercury contamination in the pilot plant area. Under each ventilating condition, the mercury contamination in the air was measured, and the volume of air flowing through the pilot plant area was also measured. The general ventilation in the pilot plant area was varied as follows:

1. With approximately 9.1 changes of air per hour flowing eastward the two exhaust fans on the second floor off and the east doors closed, the level of mercury contamination was high. The mercury concentrations in the western portion of the operating area were very low. The mercury concentration, however, gradually increased toward the eastern portion of the pilot plant. The mercury concentrations found at the various sampling points are given in Table No. 1.

2. With approximately 8.1 changes of air per hour flowing eastward through the pilot plant area, two exhaust fans running on the second floor, and the east doors closed, the general level of mercury contamination was approximately the same as that found in ventilation condition No. 1. The general level of mercury concentration was slightly lower than in condition No. 1.

[redacted]

3. With approximately 5.2 changes of air per hour flowing westward through the pilot plant, two exhaust fans running on the second floor, and the east doors open, the general pattern of the mercury concentrations was in contrast to the concentrations found in conditions No. 1 and 2. The mercury concentrations in the eastern portion of the pilot plant area were extremely low with a gradual buildup in concentration toward the west end of the operating area. The maximum concentration at the west portion of the operating area was 0.11 mg/m^3 which is only slightly above the maximum allowable concentration. This ventilation condition indicates that a slight increase in the volume of air flowing through the pilot plant area would decrease the mercury contamination well below the maximum allowable concentration.

4. On September 10, 1952, routine air samples were taken under ventilation conditions No. 1. The general level of mercury contamination was found to be extremely high throughout the plant. Also extremely high mercury concentration was found in the incoming air to the west end of the pilot plant which was found to be coming from the evaporator area. From the study of the above ventilation conditions the general level of mercury contamination was found to be the lowest with 5.2 changes of air per hour flowing westward through the pilot plant and exhausting through the main portion of the building. This direction of air flow helps to explain why the mercury contamination during June and July was so low in comparisc with the concentrations found during August and September. During June and July the east doors of the pilot plant were open and probably all the exhaust fans in the building were operating during the hot weather. With all the exhaust fans in the building running, the rate of air flowing through the operating area must have been considerably greater than 5.2 changes per hour which would account for the low concentrations observed in June and July.

   From the standpoint of contaminating the other parts of the building and the difficulty in heating the operating area in cold weather, ventilation condition No. 3 is not very desirable even though it gives the lowest level of mercury contamination in the operating area. Of course condition No. 1 would be most desirable because it has the largest volume of air flowing through the operating area. Actually ventilation condition No. 2 with 8.1 changes of air per hour is the most representative of the actual ventilation conditions found in the pilot plant area.

The above study of the possible ventilation conditions in the pilot plant area indicates that the high level of mercury contamination could be corrected by increasing the volume of air flowing through the operating area. Since the installation of additional exhaust fans would be relatively expensive because additional heating equipment would also be required, additional work was deemed necessary to locate and possibly eliminate the sources of the mercury vapors. By eliminating the sources of the mercury vapors, the level of contamination might possibly be lowered below the maximum allowable concentration.

Extremely high mercury concentrations were observed above the evaporator feed and concentrate withdrawal tanks, the feed adjusting and storage drums, the absorber and reactor effluent receiver drums, and the newly installed blender tanks. Evidently these sources of contamination are caused by the entrainment of mercury in the aqueous effluent streams from the absorbers and reactors. The temperature of these solutions is above room temperature. This elevated temperature aggravates the contamination problem because of the

large increase in vapor pressure of the mercury with the temperature increases.

The above sources of mercury vapors were eliminated by placing a partial hood over the tanks and drums and connecting the hoods to the source ventilation.

The decomposer column was found to be another source of mercury vapors because of the poor connections between the column and tray No. 12. Small drops of mercury spatters on the hot surfaces of the decomposer column and vaporizes very quickly.

Since August 1, 1952 when the increase in mercury contamination was first noticed, extreme care has been taken in housekeeping. All miscellaneous contaminated equipment stored in the operating area has been removed. Also, the stainless steel evaporator at the head of tray No. 1-1 was dismantled and removed.

Tests were made in an effort to determine the degree of mercury contamination on various surfaces in the pilot plant area. Surface contamination on the floor, walls, ceiling, operating equipment, and overhead pipes was found to be of the same order of magnitude as the general air contamination. These tests indicate that the surfaces are not grossly contaminated with mercury. Decontamination of the floor and the north wall with HgX compound failed to show an appreciable reduction in surface contamination.

The general level of mercury contamination in the operating area was considerably lower after the elimination of the mercury vapors coming from the aqueous storage tanks and drums, the decontamination of the walls and floors, and the intensified housekeeping program. The highest concentration found in the operating area was 0.10 mg/m^3 which is the maximum allowable concentration. The mercury concentrations found at the various sampling points in the pilot plant are given in Table No. 2.

The above improvements are gratifying, however it is apparent that from the standpoint of complete freedom from toxicity, further improvements must be made. Obviously, the only means of further lowering the level of contamination is by increasing the volume of air flowing through the operating area.

In other industrial plants where mercury contamination is experienced, the volume of air flowing through their operating areas varies from 10 to 20 changes of air per hour. [redacted] Company at Saltville, Va. has 10 changes of air per hour flowing through their areas in which mercury cells are used for the production of chlorine. At the plant of [redacted] Niagara Falls, N. Y., the general ventilation is 20 changes of air per hour, wherever mercury is used in processing.

To evaluate the results from increasing the volume of air flowing through the pilot plant area; the exhaust fans in the transformer room adjacent to the operating area were turned on. These fans exhaust air from the operating area through the doors located north of tray No. 11 and 12, and at the west end of the operating area. In addition to these fans in the transformer room, the covers on the rectifier exhaust ducts were opened so that the rectifier cooling fans were exhausting air into the operating area. The level of mercury contamination in the main portion of the pilot plant where the absorber and reactors trays are located dropped appreciably. The sample of air taken over the decompo column was, however, 0.10 mg/m^3, and the other samples taken along the reactor and absorber trays were approximately one-half maximum allowable concentration. However, the

air samples taken in the evaporator area were much higher than usual. The mercury concentrations found at the various sampling points are given in Table No. 2.

On October 17, 1952, special air samples were taken in the evaporator room in an effort to determine why the unusually high level of mercury contamination was found in the routine air sampling of the evaporator area on October 16, 1952. These special air samples indicate that probably the newly installed spray column is a new source of contamination which had not been found in previous air sampling of the pilot plant area. The mercury concentrations found in the special air sampling of the evaporator area are given in Table No. 3.

The conclusions and recommendations formed from the above study may be summarized as follows:

1. The high level of mercury contamination experienced in the pilot plant area since August 1, 1952 was primarily caused by closing the east doors and changing the direction of air flow.

2. The practice of using unvented tanks and drums to store warm alloy hydroxide solutions containing entrained mercury, would considerably add to the source of mercury vapors.

3. A better connection should be made between the decomposer column and tray No. 12. It may also prove necessary that a hood be constructed around the decomposer and vented away from the area.

4. Increase the volume of air flowing through the pilot plant area by using the exhaust fans in the transformer room and the rectifier cooling fans. This has already been done on a temporary basis. If this cannot be done permanently; it is recommended that additional ventilating fans be installed.

5. Additional study should be made of the newly discovered source of mercury contamination found in the evaporator area.

6. Investigate the source ventilation that will be provided for the absorber recycle, spent raffinate, and absorber feed tanks in the component testing facilities pilot plant and the full scale plant.

7. Additional study should be made of mercury vapor detectors. The General Electric Mercury Vapor Detector, which is in present use, is not very sensitive to mercury vapor below the American Standard allowable concentration for long time exposure.

G. H. Smith

G. H. Smith

GHS/lb

TABLE 1

MERCURY AIR CONTAMINATION IN ELEX PILOT PLANT AREA

Sample No.	Sample Location	MERCURY-AIR CONCENTRATION mg/m^3 Condition No. 1 — 9.1 Changes of air/hr. Flowing Eastward Sept. 8, 1952	Condition No. 2 — 8.1 Changes of air/hr. Flowing Eastward Sept. 8, 1952	Condition No. 3 — 5.2 Changes of air/hr. Flowing Westward Sept. 8, 1952	Condition No. 4 — Air Flow Similiar To Condition No. 1 Sept. 10, 1952
1	5' from exhaust fan	0.17	0.14	0.03	0.35
2	Over test table east end at b.l. *	0.17	0.14	0.02	0.41
3	At walkway 18" from tray No. 1 at b.l.	0.14	0.10	0.07	0.39
4	At walkway 18" from tray No. 3 at b.l.	0.11	0.11	0.05	0.43
5	At walkway 18" from tray No. 5 at b.l.	0.26	0.19	0.04	0.53
6	At walkway 18" from tray No. 7 at b.l.	0.19	0.16	0.03	0.45
7	At walkway 18" from tray No. 9 at b.l.	0.17	0.13	0.04	0.41
8	At walkway 18" from tray No. 11 at b.l.	0.11	0.11	0.17	0.30
9	At control pannel west end at b.l.	0.13	0.10	0.11	0.25
10	Over salvage area at b.l.	0.13	0.10	0.10	0.22
11	Over test bench west end at b.l.	0.10	0.08	0.10	0.22
12	5' from west door inside plant at b.l.	0.00	0.01	0.11	0.10
13	Corridor between pilot plant area and evaporator area				0.30
14	Above evaporator feed and condensate tank				1.10
15	Above evaporator pumping station				0.75

* breathing level

TABLE 2

MERCURY AIR CONTAMINATION IN ELEX PILOT PLANT AREA

Sample	Sample Location	MERCURY-AIR CONCENTRATION mg/m^3	
		8.1 changes of air/hr. Source ventilation on aqueous drums and intensified clean-up	Exhaust fans in transformer room on and rectifier fans exhausting into area
		Oct. 4, 1952	Oct. 16, 1952
1	5' from exhaust fan	.08	.04
2	Over titration table at east end at b.l. *	.08	.03
3	At walkway 18" from tray No. 1 at b.l.	.10	.06
4	At walkway 18" from tray No. 3 at b.l.	.08	.04
5	At walkway 18" from tray No. 5 at b.l.	.10	.04
6	At walkway 18" from tray No. 7 at b.l.	.10	.04
7	At walkway 18" from tray No. 9 at b.l.	.08	.02
8	At walkway 18" from tray No. 11 at b.l.	.06	.03
9	At control pannel at b.l.	.08	.04
10	Above decomposer column at b.l.	.06	.10
11	Over titration table west end at b.l.	.04	.06
12	5' from west end door at b.l.	.00	.03
13	Corridor between pilot plant area and evaporator area	.00	.22
14	Above evaporator feed and concentrate tank	.00	.26
15	Between tanks and evaporator	.00	.30
16	East side of evaporator	.00	.26
17	Titration table in evaporator area	.00	.16

* breathing level

TABLE 3

MERCURY AIR CONTAMINATION IN EVAPORATOR AREA

October 17, 1952

Sample No.	Sample Location	Mercury-air concentration mg/m^3
1	Breathing level above titration table by spray column	.57
2	Breathing level above feed tank to spray column	.37
3	Breathing level above feed adjusting drums for pilot plant	.20
4	Breathing level above evaporator feed and condensate tanks	.33
5	Breathing level in front of evaporators	.37
6	Breathing level above titration table near evaporators	.26
7	Near east wall (at center of wall)	.37
8	Background between evaporators and spray column	.20
9	Corridor between evaporator area and main operating area	.16

8

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